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Pruning and Training Tomatoes in the South

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PROS AND CONS OF PRUNING AND TRAINING

In many parts of the United States tomatoes are pruned and trained. The amount of pruning and the methods of training vary, but the commonest practice is to prune the plant to a single stem and tie it to a stake. There seems to be no general agreement as to the value of the practice.

Arguments for and against the practice have been advanced by growers and experimental workers. Thompson (11, p. 465)³ summarized these as follows:

The advantages claimed for pruning and training are (1) earlier ripening, (2) larger fruits, (3) less disease injury, (4) larger yields, (5) cleaner fruit, (6) more convenient harvesting, and (7) greater convenience for spraying. The disadvantages usually mentioned are (1) greater amount of labor and expense, (2) less total yield, (3) greater loss from blossom-end rot, (4) more sunburn on the fruit, (5) greater amount of cracking.

¹ Died April 1, 1941.

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³ Italic numbers in parentheses refer to Literature Cited, p. 16.

Another advantage claimed by some workers for pruning and training is the ease of cultivation for weed control, especially on some of the heavier soils or on those that tend to bake or form a crust.

Several questions have arisen in the southern tomato-producing areas in regard to pruning and training of tomatoes: Is the locally prevailing method of pruning and training to a single stem the best practice? Is it possible to improve yields and quality of pack at no additional cost of production? Or is it possible to obtain a greater profit and more satisfactory production by changing the pruning and training practice, even though some increase in cost of production may be involved? Can the plants be trained so as to keep the fruits off the ground and still permit the plants to develop their normal size and leaf area? With a normal top, will marketable yields, especially of the early marketable fruit, be increased? Will the damage from blossom-end rot be decreased? Will the quality of the pack be otherwise improved?

To help answer these and many other questions concerning the culture of tomatoes, experiments were carried on at several locations in Mississippi. Their object was to determine the effect of pruning and training tomato plants on total yield, yields of marketable and early marketable fruit, size of fruit, culls, "crooks" (gnarled or misshapen fruits), and blossom-end rot.

In the period 1937-41, 14 tests were conducted in 3 districts to determine the relative value of 5 methods of pruning and staking tomatoes as compared with no pruning and no staking. The results of these tests showed that pruning and training are good practices in the South when tomatoes are grown for the market, especially for the early market, and when labor and materials are available. Of the methods tried, pruning and training to 2 stems gave the best results. Topping did not prove to be a worth-while practice. These results in more detail are summarized as follows:

The tests indicated that under Mississippi conditions pruning to two stems was more profitable than pruning to one stem. The tomatoes yielded by an acre of pruned and staked plants (spaced 2 by 4 feet) have a greater net value than those from an acre of unpruned ones (spaced 4 by 4 feet). (See table 13.)

The average size of total marketable fruits was greater on the pruned and staked plants; however, the average size of early marketable fruits was apparently unaffected by the treatments.

The yields per acre of early marketable fruit, total marketable fruit, and total fruit were all more on pruned and staked plants, even though the yields per plant were less. Plants pruned to two stems had the largest total of marketable fruits and largest total yield per acre at all three locations.

Pruning and training had relatively little effect upon the percentage of the total yield that was marketable. Slightly smaller percentages of the total yields per acre from pruned and staked tomatoes were No. 3's and culls, whereas slightly larger percentages from such plants were "crooks," catfaced fruit, or fruit affected with blossom-end rot.

Topping had no consistent or significant effect on yield or quality of fruit.

SOME RESULTS OBTAINED ELSEWHERE

No attempt will be made to review all the literature on the pruning and training of tomatoes or related factors that might affect the production of tomatoes when trained and pruned. However, the literature cited shows the trends of thought in various sections of the United States and Canada.

While the experimental evidence on the value of pruning and training tomatoes seems to be contradictory, it must be remembered that there are marked differences in many of the factors entering into the numerous experiments, such as length of growing season, light, temperature, precipitation, prevalence of disease, soil management, and soil fertility. The human element also enters into each experiment in the form of the individual or personal viewpoint in the interpretation of the data. This is especially true of the early work that was not conducted so that it could be analyzed statistically.

From a review of the literature it seems that pruning and training tomatoes is profitable to some degree: (1) In regions of relatively short growing season; (2) in regions of relatively high altitude; (3) in market-garden areas where land value is very high and the greatest yield per acre must be obtained; (4) in areas where the period of marketing tomatoes at a profit is very short; (5) in very humid areas where the fruits are subject to rots of various kinds when they come in contact with the soil; and (6) in those places where the nature of the soil requires that it be cultivated frequently in order to produce the best plant growth and to control weeds.

Woods (16) at Agassiz, British Columbia, found that maturity was hastened and yield decreased in proportion to the amount of pruning and that unchecked plants trained to a single stem gave the most satisfactory results when earliness and total yield were considered. Walker (12), working at Indian Head, Saskatchewan, found that tomatoes pruned to two and three trusses gave a greater yield of ripe fruit than plants not pruned but that pruning reduced the total yield in proportion to its severity.

Currence (1), in Minnesota, using three varieties of tomatoes representing the dwarf, self-pruning, and standard types, found that the total yields per plant of all types were consistently reduced by the pruning treatment and that staking without pruning produced yields approximately equal to those of the untreated plots. Staking, especially staking plus pruning, generally seemed to increase fruit size. He found that pruning the standard-type tomato increased early yields but tended to reduce early yields of the self-topping, or determinate, type of tomato.

Magruder (5), on the basis of 1 year's work in Ohio, reported an increase in the yield of early fruit but a decreased total yield in proportion to the severity of the pruning.

Whipple and Schermerhorn (14) found that under Montana conditions pruned plants produced ripe fruits at least 2 weeks earlier than unpruned ones. Because of the short season this earliness resulted in greater yields of marketable fruit. They reported that in nearly every case pruned plots produced three to five times as much ripe fruit as unpruned ones. They pointed out that pruning does reduce the total yield when both green and ripe fruit are considered but that, as a rule, green fruit is of little interest.

Edmond (2) found that pruned plants produced more marketable tomatoes than the unpruned plants during the usual shipping period in Mississippi. His results also showed that there were no significant differences between the total of marketable fruit per acre of the staked, topped, pruned plants and of the unstaked, untopped, unpruned plants.

Wicks (15) in Idaho found that the largest number of first-ripe fruit was obtained from plants pruned to one stem and that total yields were decreased with increased severity of pruning. The greatest net profit was derived from the plants that were neither pruned nor staked.

Thompson (10) reported that in New York the main advantage derived from pruning and staking was increased early yield, due primarily to the larger number of pruned plants per acre. The total yield of marketable fruit per plant was much less on plants pruned to one stem and tied to stakes than on those unpruned and unstaked.

Hawthorn (3) found that in the Winter Garden district of Texas unstaked tomatoes pruned to one or two stems gave a greater yield of early marketable fruit than the unpruned plants but that later in the season they were outyielded by the unpruned plants.

Stuckey (9) reported results of an experiment in Georgia in which pruned plants produced a larger yield per acre than unpruned plants.

Lloyd and Brooks (4) in Illinois found that pruning did not increase the amount of early fruit when considered on a per plant basis but that the total yield of marketable fruit per plant decreased with increased severity of pruning.

Watts (13) found that pruning tomato plants reduced early and total yields per acre at Fayetteville, Ark., while no significant differences in yield per acre resulted from pruning at Hope.

In Missouri, Rosa (7) reported a slight, though probably insignificant, increase in early yield of pruned and staked plants as compared with that of plants staked but unpruned. Total yield per acre of pruned plants was lower than that of unpruned plants.

MATERIALS AND METHODS

The work reported in this circular was carried on at the following locations: The U. S. Horticultural Field Station, Meridian, Miss., from 1937 to 1941, inclusive; the Horticultural Farm, State College, Miss., during 1937 and 1938; and in the Crystal Springs, Miss., district from 1937 to 1940, inclusive. In this discussion the three localities will be referred to as State College, Crystal Springs, and Meridian.

At State College the plots were located on Catalpa silt loam; at Crystal Springs, on Lexington silt loam of the Memphis-Grenada soil area; and at Meridian on soil types that ranged from Ruston loam to Ruston sandy loam of the Norfolk-Ruston soil area.

At State College a 4-8-4 fertilizer was applied in the row at the rate of 1,000 pounds per acre and the plants were side-dressed with 100 pounds of nitrate of soda per acre. At Crystal Springs a 4-8-4 fertilizer was applied at the rate of 1,250 to 1,500 pounds per acre in the row and the plants were side-dressed with 200 pounds of nitrate of soda per acre, in accordance with local practice. At Meridian a 4-8-4 fertilizer was applied in the rows at the rate of 500 pounds per

acre and the plants were side-dressed with 100 pounds of nitrate of soda per acre.

The Gulf State Market variety was used for this study because it was the most popular one grown in the district at the time the work was done. In 1940 one test with the Marglobe variety was set up at Meridian in addition to that with the Gulf State Market.

Each test was set up as a Latin square with 6 treatments replicated 6 times. Plots consisted of single rows of 50 pruned or 25 unpruned plants each. All rows were 4 feet apart; pruned plants were 2 feet apart and unpruned ones 4 feet apart in the rows.

The pruning and training treatments that the plants received were as follows:

(1) Pruned to one stem, staked, topped (fig. 1, A). As branches ("suckers") appeared they were pinched out. After three flower clusters had formed and the fruit had set, the main growing tip was also pinched out.

(2) Pruned to one stem, staked, not topped (fig. 1, B). Same as treatment 1 except for omission of topping.

(3) Pruned to two stems, staked, topped (fig. 1, C). The two stems were the main stem and the first branch; all other branches were pinched out as they appeared. After three flower clusters on the main stem and two on the branch had formed and the fruit had set, the growing tip of each was pinched out.

(4) Pruned to two stems, staked, not topped (fig. 1, D). Same as treatment 3 except for omission of the pinching-out of the tips of the two stems.

(5) Staked, not pruned (fig. 2, A). All branches were allowed to develop, and the entire plant was tied to a stake.

(6) Unpruned, unstaked (fig. 2, B). Before the untreated plant began to fall to the ground a circle about 3 feet in diameter about it was mulched with pine straw to keep the fruits off the soil.

The fruits were picked as soon as they reached the green-wrap stage. The data on number and weight of fruits recorded and analyzed in this study included the No. 1 and No. 2 grades of marketable fruit, the total early marketable fruit (the first three pickings of grades No. 1 and No. 2), the No. 3 fruit, culls, "crooks," those, with blossom-end rot, and the total yield.

The analysis of variance for the individual tests or locations was made according to Snedecor (8). In combining the data of the several tests those of the 2 at State College were put in 1 group, those of the 6 at Crystal Springs in a second group, and those of the 6 at Meridian in a third group. Results of tests at all 3 locations were then combined, 14 in all. The groupings were keyed out according to Paterson's (6) method for replicated Latin squares.

RESULTS OF PRUNING AND TRAINING

YIELDS OF EARLY MARKETABLE TOMATOES

Fruit of grades No. 1 and No. 2 was considered marketable, and the first three pickings were considered as early marketable. The early marketable yields in the tests at State College, Crystal Springs, and Meridian are shown in table 1, and the combined results for the three locations are presented in table 2.



FIGURE 1.—Tomato plants showing four of the treatments: *A*, Pruned to one stem, staked, topped; *B*, pruned to one stem, staked, not topped; *C*, pruned to two stems, staked, topped; *D*, pruned to two stems, staked, not topped.



FIGURE 2.—Tomato plants illustrating two of the six treatments: *A*, Staked, unpruned; *B*, unstaked, unpruned.

TABLE 1.—Mean yield per acre of early marketable tomatoes from 6 different treatments at 3 locations, 1937-41

Location and treatment	Spac- ing	1937		1938		1939	1940		1941	Mean
		Test 1	Test 2	Test 1	Test 2	Test 1	Test 1	Test 2	Test 1	
<i>State College</i>										
Pruned and staked:	<i>Feet</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
1 stem, topped	4 x 2	1.19		3.37						2.28
1 stem, not topped	4 x 2	1.12		3.12						2.12
2 stems, topped	4 x 2	1.30		2.80						2.05
2 stems, not topped	4 x 2	.76		2.79						1.78
Not pruned but staked	4 x 4	.46		1.41						.94
Neither pruned nor staked	4 x 4	.48		1.43						.96
Difference required for significance at 5-percent level		.39		.75						.41
<i>Crystal Springs</i>										
Pruned and staked:										.
1 stem, topped	4 x 2	.99	1.12	4.58	3.67	1.27	3.04			2.44
1 stem, not topped	4 x 2	.92	1.36	4.51	3.70	1.07	3.14			2.45
2 stems, topped	4 x 2	1.21	1.09	5.54	4.05	1.50	3.06			2.74
2 stems, not topped	4 x 2	1.15	1.39	4.95	3.98	1.24	3.41			2.70
Not pruned but staked	4 x 4	.51	.96	1.61	1.68	.81	1.35			1.15
Neither pruned nor staked	4 x 4	.41	.52	2.15	1.82	.47	1.53			1.15
Difference required for significance at 5-percent level		.54	.34	.63	.82	.35	.85			.24
<i>Meridian</i>										
Pruned and staked:										
1 stem, topped	4 x 2	.91		3.65		2.27	1.60	3.58	0.46	2.08
1 stem, not topped	4 x 2	.92		3.25		2.34	1.75	3.55	.28	2.01
2 stems, topped	4 x 2	.93		3.96		1.68	1.80	3.02	.26	1.94
2 stems, not topped	4 x 2	1.12		4.21		1.66	1.47	3.79	.36	2.10
Not pruned but staked	4 x 4	.63		4.38		.92	.54	1.90	.10	1.42
Neither pruned nor staked	4 x 4	.80		3.68		1.24	.60	1.95	.31	1.43
Difference required for significance at 5-percent level		.22		1.07		.55	.32	.58	.02	.23

TABLE 2.—Mean yield per acre of early marketable and total marketable tomatoes from 6 different treatments

[Each value is based on 14 tests (table 1 or 5)]

Treatment	Early marketable fruit	Total marketable fruit
Pruned and staked:	<i>Tons</i>	<i>Tons</i>
1 stem, topped	2.27	4.60
1 stem, not topped	2.22	5.05
2 stems, topped	2.30	5.76
2 stems, not topped	2.31	5.67
Not pruned but staked	1.23	3.47
Neither pruned nor staked	1.24	3.39
Difference required for significance at 5-percent level	.15	.36

The pruned and trained plants were definitely superior to the unpruned ones in production per acre of early marketable fruit at all locations. At State College the one-stem, topped plants produced a significantly larger early marketable yield than the two-stem, untopped, while at Crystal Springs both groups of two-stem plants produced significantly larger yields than the single-stem ones. There were no significant differences in the early marketable yield among the pruned and trained plants at Meridian.

At no location did topping significantly benefit early yield of pruned plants. Unpruned plants produced approximately half as much early marketable fruit per acre as the pruned ones, all locations considered.

There were no significant differences in the early marketable yields between the two unpruned groups of plants at any one of the three stations or in the combined results.

When considered on a per plant basis (table 3), the only significant differences in early marketable yields between treatments at State College were those between one stem, topped, and two stems, not topped, with the former producing the larger yield per plant. Yields of plants pruned to two stems were significantly higher than those from the other treatments at Crystal Springs, while at Meridian and in the combined results the unpruned-plant yields were significantly higher than those of other treatments.

Table 4 gives the yields of early marketable fruit expressed as percentages of the total marketable fruit.

TABLE 3.—*Mean yield per plant of early marketable, total marketable, and all tomatoes from 6 different treatments at 3 locations*

Treatment	State College			Crystal Springs			Meridian			Mean for 3 locations (14 tests)		
	Early marketable	Total marketable	All	Early marketable	Total marketable	All	Early marketable	Total marketable	All	Early marketable	Total marketable	All
Pruned and staked:	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>	<i>Lbs.</i>
1 stem, topped.....	0.84	2.39	3.23	0.90	1.42	2.69	0.76	1.73	2.77	0.83	1.69	2.80
1 stem, not topped.....	.78	2.57	3.41	.90	1.50	2.71	.74	1.97	3.09	.81	1.86	2.97
2 stems, topped.....	.75	3.38	4.49	1.01	1.74	3.24	.71	2.03	3.32	.85	2.10	3.45
2 stems, not topped.....	.65	3.50	4.59	.99	1.74	3.20	.77	1.95	3.20	.85	2.08	3.40
Not pruned but staked.....	.69	4.28	6.17	.85	1.67	3.33	1.04	2.87	4.73	.91	2.55	4.35
Neither pruned nor staked.....	.70	2.87	4.51	.84	1.74	3.59	1.05	3.12	5.24	.91	2.49	4.43

TABLE 4.—*Percentage of total marketable tomatoes that were early marketable at 3 locations, harvested from 6 different treatments*

Treatment	State College (2 tests)	Crystal Springs (6 tests)	Meridian (6 tests)	Mean for 3 locations (14 tests)
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Pruned and staked:				
1 stem, topped.....	35.0	63.0	44.1	49.3
1 stem, not topped.....	30.3	60.0	37.4	44.0
2 stems, topped.....	22.3	57.7	35.0	39.9
2 stems, not topped.....	18.7	56.8	39.5	40.7
Not pruned but staked.....	16.2	50.7	36.4	35.4
Neither pruned nor staked.....	24.6	48.7	33.6	36.6

YIELDS OF TOTAL MARKETABLE TOMATOES

The total marketable yields of tomatoes per acre obtained in the tests at State College, Crystal Springs, and Meridian are shown in table 5, and the combined results at the three locations in table 2.

TABLE 5.—*Mean yield per acre of total marketable tomatoes from 6 different treatments at 3 locations, 1937-41*

Location and treatment	Spacing	1937		1938		1939	1940		1941	Mean
		Test 1	Test 2	Test 1	Test 2	Test 1	Test 1	Test 2	Test 1	
<i>State College</i>										
Pruned and staked:	<i>Feet</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
1 stem, topped	4x2	5.31		7.71						6.51
1 stem, not topped	4x2	5.08		8.92						7.00
2 stems, topped	4x2	7.43		10.95						9.19
2 stems, not topped	4x2	8.35		10.72						9.53
Not pruned but staked	4x4	4.28		7.36						5.82
Neither pruned nor staked	4x4	2.74		5.07						3.90
Difference required for significance at 5-percent level		1.54		2.31						1.34
<i>Crystal Springs</i>										
Pruned and staked:										
1 stem, topped	4x2	3.19	2.21	6.38	5.57	1.54	4.29			3.87
1 stem, not topped	4x2	3.82	2.83	6.34	5.82	1.35	4.33			4.08
2 stems, topped	4x2	4.42	2.52	8.15	6.75	2.04	4.61			4.75
2 stems, not topped	4x2	4.34	3.05	7.70	6.58	1.82	4.99			4.75
Not pruned but staked	4x4	2.96	1.69	3.04	2.67	1.17	2.08			2.27
Neither pruned nor staked	4x4	2.44	1.46	4.24	3.04	.73	2.28			2.36
Difference required for significance at 5-percent level		1.05	.80	1.01	.85	.43	1.05			.34
<i>Meridian</i>										
Pruned and staked:										
1 stem, topped	4x2	1.76		3.92		5.27	5.00	11.17	1.18	4.72
1 stem, not topped	4x2	2.45		3.57		5.48	6.02	13.68	1.03	5.37
2 stems, topped	4x2	3.98		4.68		5.11	5.95	12.37	1.16	5.54
2 stems, not topped	4x2	4.02		5.18		5.18	4.92	11.21	1.35	5.31
Not pruned but staked	4x4	5.11		4.59		2.92	2.91	7.33	.55	3.90
Neither pruned nor staked	4x4	4.19		4.83		3.06	3.39	7.96	2.05	4.25
Difference required for significance at 5-percent level		.72		1.53		.98	1.22	3.28	.70	.63

TABLE 6.—*Percentage of total tomato yield that was marketable, harvested from 6 different treatments at 3 locations*

Treatment	State College (2 tests)	Crystal Springs (6 tests)	Meridian (6 tests)	Mean for 3 locations (14 tests)
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Pruned and staked				
1 stem, topped	74.1	52.9	62.7	60.4
1 stem, not topped	75.4	55.2	63.9	62.6
2 stems, topped	75.3	53.7	61.4	60.8
2 stems, not topped	76.3	54.5	60.9	61.2
Not pruned but staked	69.4	50.0	60.6	58.6
Neither pruned nor staked	63.5	48.2	59.6	56.2

Pruning to two stems and staking gave the best results at State College, at Crystal Springs, and for the three locations combined. At Meridian, plants pruned to one stem and not topped yielded essentially the same as the plants pruned to two stems. The pruned and trained plants at each station showed significantly greater yields per acre than the unpruned plants, largely because there were twice as many per acre. Topping had no consistent effect on total marketable yield.

At State College the total yield of marketable fruit per plant (table 3) from the staked and unpruned treatment was greatest; those from the two-stem treatments were next. At Crystal Springs plants pruned to a single stem yielded less per plant than those that received the other four treatments, which yielded similarly. At Meridian the

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unpruned plants were definitely superior to the pruned in yield per plant, as was also the case when the results at the three locations were averaged. There was no consistent effect of topping on total yield of marketable fruit per plant in the pruned treatments.

Table 6 shows the yield of total marketable tomatoes expressed as percentage of the total yield at the various locations and the combined locations. There were no great differences in the percentages of total marketable fruit that could be attributed to the treatments.

SIZE OF FRUITS

Table 7 shows that the treatments produced no significant differences in the size of the early marketable tomatoes at any of the locations or for the mean of three locations.

TABLE 7.—Mean weight of early marketable tomatoes from 6 different treatments at 3 locations, 1937-41

Treatment	State College			Crystal Springs									Meridian									Mean for 3 locations (14 tests) ¹
	1937	1938	Mean ¹	1937		1938		1939	1940	Mean ¹	1937	1938	1939	1940		1941	Mean ¹					
				Test 1	Test 2	Test 1	Test 2							Test 1	Test 2							
Pruned and staked:	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.				
1 stem, topped.....	5.02	6.07	5.54	4.31	4.42	5.27	5.64	4.28	5.32	4.87	5.84	5.47	4.02	5.79	7.01	4.96	5.51	5.24				
1 stem, not topped.....	4.87	6.48	5.67	4.48	4.63	5.10	5.47	4.01	5.65	4.89	5.86	5.58	4.15	5.92	7.05	4.63	5.53	5.28				
2 stems, topped.....	5.57	6.60	6.08	4.31	4.52	5.50	5.34	4.29	5.71	4.95	5.36	5.38	5.16	6.35	7.37	4.91	5.59	5.38				
2 stems, not topped.....	5.31	6.72	6.01	4.13	4.51	5.17	5.12	4.18	5.52	4.77	6.19	5.36	4.25	6.34	7.30	4.76	5.70	5.35				
Not pruned but staked.....	5.30	6.55	5.92	4.25	4.79	4.60	5.01	4.51	5.42	4.76	5.82	5.23	3.95	5.98	7.32	4.69	5.50	5.24				
Neither pruned nor staked.....	5.36	5.76	5.56	4.44	4.09	4.81	5.30	4.27	5.61	4.75	5.89	4.76	4.15	5.98	7.25	5.06	5.52	5.19				

¹ No significant difference among treatments at the 5-percent level.

Table 8 shows that there were some differences in size of the total marketable fruit due to treatment. At State College in 1937, plants pruned to two stems, not topped, and staked produced fruit about one-third of an ounce larger than plants that were not pruned but staked and about one-half an ounce larger than plants that were neither pruned nor staked. Pruning and staking in all instances increased the fruit size over that from the unpruned and unstaked plants. In 1938, pruned and staked and unpruned but staked plants produced larger fruit than the unpruned, unstaked plants.

At Crystal Springs in 1938 there were two tests. In test 1 plants pruned to one stem, topped, and staked and those pruned to two stems, topped, and staked bore larger fruit than the unpruned, staked or unstaked plants. In test 2 pruning and staking increased the fruit size over that of fruit on the unpruned plants. There were no significant differences among the pruned and staked plants in 1938. In 1938 at Meridian, plants pruned to one stem, not topped, and staked bore larger fruit than those that were pruned to two stems, whether topped or not topped, and larger than those of staked and unpruned plants. Plants pruned to one stem, topped, and staked produced larger fruit than plants that were neither staked nor pruned.

TABLE 8.—*Mean weight of total marketable tomatoes from 6 different treatments at 3 locations, 1937-41*

Treatment	State College			Crystal Springs							Meridian							Mean for 3 locations (14 tests)
	1937	1938	Mean	1937		1938		1939	1940	Mean	1937	1938	1939	1940		1941	Mean	
				Test 1	Test 2	Test 1	Test 2							Test 1	Test 2			
Pruned and staked:	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	Oz.	
1 stem, topped.....	5.09	6.38	5.73	3.78	4.05	5.14	5.39	4.15	5.07	4.60	5.98	5.16	4.34	5.37	7.11	4.74	5.45	
1 stem, not topped.....	5.10	6.35	5.72	4.48	4.07	4.87	5.43	3.90	5.46	4.70	5.99	5.75	4.21	5.46	7.21	4.54	5.53	
2 stems, topped.....	5.33	6.29	5.81	3.76	4.19	5.04	5.19	4.12	5.08	4.56	5.71	4.89	4.48	5.56	7.19	4.79	5.44	
2 stems, not topped.....	5.22	6.18	5.70	4.12	4.27	4.80	5.21	4.01	5.14	4.59	6.15	4.93	4.42	5.38	7.08	4.73	5.45	
Not pruned but staked.....	4.99	6.08	5.54	3.93	4.14	4.32	4.20	4.10	4.93	4.27	5.88	4.76	4.11	5.03	6.67	4.62	5.18	
Neither pruned nor staked.....	4.74	5.45	5.09	4.09	3.55	4.39	4.46	3.99	5.15	4.27	5.72	4.40	4.22	4.95	6.79	4.85	5.15	
Difference for significance at 5-percent level.....	.32	.43	.26	(1)	(1)	.64	.63	(1)	(1)	.21	(1)	.71	(1)	.37	.29	(1)	.16	

¹ Replicates not counted separately.

In 1940 there were two tests at Meridian. In test 1 the pruned and staked treatments showed an increase in fruit size over the neither staked nor pruned treatment. Plants pruned to one stem, not topped, and staked and those pruned to two stems, topped, and staked bore larger fruit than the unpruned plants. In test 2 the pruned and staked treatments showed an increase in fruit over the unpruned treatments.

On the whole, at State College, plants pruned to two stems, topped, and staked bore larger fruit than the unpruned ones, while the pruned and staked treatments and the unpruned and staked treatments increased the fruit size over the unpruned and unstaked treatment. At Crystal Springs and at Meridian and in the three locations combined there was no significant increase in fruit size among the pruned and staked treatments, but these did increase the size of fruit over that of the unpruned treatments.

TOTAL YIELDS

Table 9 shows that at all stations plants pruned to two stems and staked yielded more total fruit per acre than those trained to one stem and staked and more than unpruned plants. At Meridian, plants pruned to one stem and not topped equaled in yield plants pruned to two stems. Unpruned plants produced more fruit per plant than pruned plants at Crystal Springs and Meridian and the three stations combined (table 3). At State College unpruned, staked plants produced the greatest total amount of fruit per plant.

TABLE 9.—*Mean total yield of tomatoes per acre from 6 different treatments at 3 locations*

Treatment	State College (2 tests)	Crystal Springs (6 tests)	Meridian (6 tests)	Mean for 3 locations (14 tests)
Pruned and staked:	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
1 stem, topped.....	8.79	7.32	7.53	7.62
1 stem, not topped.....	9.28	7.39	8.41	8.10
2 stems, topped.....	12.21	8.84	9.03	9.40
2 stems, not topped.....	12.49	8.71	8.72	9.26
Not pruned but staked.....	8.39	4.54	6.44	5.90
Neither pruned nor staked.....	6.14	4.90	7.13	6.03
Difference required for significance at 5-percent level.....	1.42	.50	.71	.42

YIELDS OF NO. 3 AND CULL TOMATOES

Table 10 shows that at State College there was very little difference in the percentage of the total yield that were No. 3's and culls in the pruned and staked treatments. The unpruned but staked treatment had about 10 percent more culls, and the unpruned, unstaked treatment had 15 percent more culls than the pruned and staked treatments. At Crystal Springs there was little difference in the proportions of culls in the pruned and staked treatments. There was a difference from year to year and between tests in a given year, but this was not due to treatment. The unpruned and staked treatment mean was approximately 5 percent greater and the unpruned, unstaked treatment mean approximately 11 percent greater than the pruned and staked treatment means. There was little difference in the mean percentages of the pruned and staked treatments at Meridian. There was approximately 4 percent more No. 3 and cull fruits in the unpruned and staked and 6 percent more in the unpruned, unstaked treatment than in the pruned and staked treatment.

TABLE 10.—Percentage of total yield that was No. 3 and cull grades, harvested from 6 different treatments at 3 locations

Treatment	State College			Crystal Springs									Meridian							Mean for 3 locations (14 tests)
	1937	1938	Mean	1937		1938		1939	1940	Mean	1937	1938	1939	1940		1941	Mean			
				Test 1	Test 2	Test 1	Test 2							Test 1	Test 2					
Pruned and staked:	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.		
1 stem, topped	15.7	14.7	15.1	31.1	34.6	21.4	22.6	54.7	27.0	28.9	38.9	21.0	31.6	22.1	7.8	56.9	24.1	24.5		
1 stem, not topped	18.2	11.8	14.2	26.6	31.3	17.9	19.6	59.6	25.3	26.5	31.2	17.7	37.1	22.4	6.4	58.8	23.6	23.2		
2 stems, topped	16.8	14.3	15.3	24.6	31.7	18.6	21.7	50.7	26.1	25.8	32.1	23.6	35.0	16.7	8.8	62.0	24.8	23.5		
2 stems, not topped	13.9	15.1	14.6	25.7	27.7	19.3	20.8	52.9	25.3	25.5	30.1	17.8	34.8	20.3	10.2	59.3	24.8	23.1		
Not pruned but staked	21.9	27.1	25.2	31.2	33.9	23.3	30.3	56.7	26.9	31.8	29.4	23.8	43.3	25.9	11.2	70.3	28.6	29.0		
Neither pruned nor staked	30.2	30.8	30.6	38.7	38.2	30.2	39.8	66.8	26.6	37.4	32.8	23.0	43.6	23.5	9.3	59.8	30.2	32.8		

The means for the 3 locations (14 tests) show that the differences between treatments are the same as those at Crystal Springs, State College, and Meridian. The unpruned, staked treatment produced about 6 percent more No. 3 and cull fruits and the unpruned, unstaked treatment about 9 percent more than the pruned and staked treatments.

It should be noted that although the percentage of No. 3 and cull fruits varied from year to year and between tests in a given year, the same general relation between treatments held throughout the experiments.

YIELDS OF "CROOKS" AND CATFACED TOMATOES

Strictly speaking, "crooks" and "catfaces" are culls that are very gnarled or misshapen. In this study they were separated from other culls to see whether pruning and training had any effect on the yield of such fruit. Table 11 shows that at State College the pruned treatments produced 3 percent or more of them than the unpruned treatments when expressed as percentages of the mean total yields of fruit. At Crystal Springs and Meridian and when the 14 tests were averaged, the percentages of the total yields that were "crooks" or catfaced fruit seemed to have little relation to the treatments.

TABLE 11.—*Percentage of total yield of tomatoes per acre that was "crooks" and cat-faced fruits, harvested from 6 different treatments at 3 locations*

Treatment	State College			Crystal Springs						Meridian						Mean for 3 locations (14 tests)		
	1937	1938	Mean	1937		1938		1939	1940	Mean	1937	1938	1939	1940			1941	Mean
				Test 1	Test 2	Test 1	Test 2							Test 1	Test 2			
Pruned and staked:	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	
1 stem, topped.....	6.8	10.5	9.1	11.8	15.4	11.7	10.7	5.4	12.5	11.5	4.6	6.7	0.6	9.5	7.9	7.2	6.2	8.8
1 stem, not topped.....	8.9	10.6	9.9	14.4	12.0	10.6	10.5	4.3	11.6	11.0	4.8	6.3	.6	8.8	6.2	9.6	5.7	8.5
2 stems, topped.....	6.4	10.4	8.7	15.4	14.7	11.7	10.7	3.0	12.8	11.9	8.0	6.0	.6	10.9	10.8	10.4	7.9	9.7
2 stems, not topped.....	8.2	9.0	8.7	12.7	15.4	11.6	12.3	4.5	12.1	11.9	7.4	7.4	.5	11.6	9.8	10.0	7.7	9.6
Not pruned but staked.....	6.3	4.2	5.0	11.8	13.6	9.0	11.2	2.2	11.4	10.2	9.4	4.7	.6	8.4	8.5	8.1	6.8	7.5
Neither pruned nor staked.....	6.6	5.1	5.7	12.6	13.1	11.1	11.3	3.0	7.5	10.5	8.9	5.2	.8	7.7	9.5	6.9	6.8	7.9

YIELDS OF TOMATOES AFFECTED WITH BLOSSOM-END ROT

Table 12 shows the effect of the various treatments on blossom-end rot. The percentage of fruit with blossom-end rot tended to increase when the plants were staked and not pruned; it almost doubled when pruning was used in conjunction with staking. The percentage of blossom-end rot varied from year to year, between tests in a given year, and between locations. When considered from the standpoint of percentage of the mean total yield for all tests combined, plants neither pruned nor staked had approximately 3 percent of the crop affected with blossom-end rot. Plants that were staked and not pruned had approximately 5 percent of the crop affected, whereas those staked and pruned had approximately 6 percent of the crop affected.

TABLE 12.—*Percentage of total yield of tomatoes affected with blossom-end rot, harvested from 6 different treatments at 3 locations*

Treatment	State College			Crystal Springs									Meridian								Mean for 3 locations (14 tests)
	1937	1938	Mean	1937		1938		1939	1940	Mean	1937	1938	1939	1940		1941	Mean				
				Test 1	Test 2	Test 1	Test 2							Test 1	Test 2						
Pruned and staked:	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>			
1 stem, topped.....	0.006	0.026	0.018	9.5	8.5	9.0	3.9	2.8	5.7	6.8	15.9	15.8	8.2	1.6	2.2	6.1	7.0	6.0			
1 stem, not topped.....	.005	.004	.004	6.2	9.4	12.9	2.7	1.9	6.6	7.3	20.0	19.2	5.8	1.3	1.1	6.5	6.9	5.9			
2 stems, topped.....	.010	.005	.007	11.5	11.1	14.0	3.1	3.4	4.3	8.7	9.8	15.6	8.2	.8	.9	3.4	6.0	6.1			
2 stems, not topped.....	.005	.004	.004	9.4	10.2	13.5	4.4	1.4	3.9	8.0	15.3	14.4	6.5	1.2	1.0	2.5	6.6	6.1			
Not pruned but staked.....	.004	.005	.003	5.3	8.5	18.3	4.4	.9	7.9	8.4	6.8	5.6	7.9	.5	.4	.5	4.1	4.8			
Neither pruned nor staked.....	.001	.002	.001	3.2	1.3	6.6	1.4	1.6	5.2	3.7	6.7	4.2	7.1	1.3	.9	.7	3.5	3.2			

ESTIMATED COSTS OF AND PROFITS FROM DIFFERENT TREATMENTS

Whether tomatoes are to be pruned and staked would depend largely upon the profit per acre from the practice at prices that prevail during harvest, but soil type, climatic conditions, and type of market cannot be ignored. Pruning and training increase the cost of production per acre, and, therefore, for the practice to be profitable the gross returns must be considerably greater than those from the unpruned plants. To obtain this increased return the plants would have to be set much closer than the unpruned ones. When pruned plants set 2 feet by 4 feet apart are compared with the unpruned, unstaked plants set 4 feet by 4 feet apart, the added expense of the following items must be considered: 2,722 additional plants, 5,445 stakes, and the labor required for setting, removing, and storing 5,445 stakes. Additional labor would be required for setting the 2,722 additional plants and for pruning and tying the 5,445 plants 4 or 5 times.

Table 13 gives the estimated cost of producing an acre of tomatoes by the various treatments used in these tests. It also shows the mean yield of total marketable fruit from the 14 tests at the 3 locations, the gross value, and the net value per acre for each treatment.

From this table it can readily be seen that under Mississippi conditions it pays to prune and stake tomatoes and that pruning to two stems pays better than pruning to one.

TABLE 13.—*Estimated costs of growing an acre of market tomatoes and the net values of the crop from each of 6 different treatments*

Treatment	Spacing	Stakes ¹	Staking at 55cents per 1,000	Tying ² at \$1 per 1,000	Pruning ³ \$1 per acre at each pruning	Cord for tying	Removal and storage of stakes	Plants at \$1 per 1,000
Pruned and staked:	<i>Feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
1 stem, topped.....	4 x 2	4.35	3.00	5.45	5.00	0.50	1.00	5.45
1 stem, not topped.....	4 x 2	4.35	3.00	5.45	4.00	.50	1.00	5.45
2 stems, topped.....	4 x 2	4.35	3.00	10.90	7.00	.50	1.00	5.45
2 stems, not topped.....	4 x 2	4.35	3.00	10.90	6.00	.50	1.00	5.45
Not pruned but staked.....	4 x 4	2.17	1.50	2.72	-----	.25	.50	2.72
Neither pruned nor staked.....	4 x 4	-----	-----	-----	-----	-----	-----	2.72

Treatment	Setting plants at \$1 per 1,000	Land rent, preparation, fertilizer, and cultivation	Picking and handling at \$4 per ton	Total cost of production	Mean yield (14 tests)	Gross ⁴ value	Net value
Pruned and staked:	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Tons</i>	<i>Dollars</i>	<i>Dollars</i>
1 stem, topped.....	5.45	35.00	18.40	83.60	4.60	199.41	115.81
1 stem, not topped.....	5.45	35.00	20.20	84.40	5.05	218.92	134.52
2 stems, topped.....	5.45	35.00	23.10	95.75	5.76	249.70	153.95
2 stems, not topped.....	5.45	35.00	22.65	94.30	5.67	245.79	151.49
Not pruned but staked.....	2.72	35.00	13.90	61.48	3.47	150.42	88.94
Neither pruned nor staked.....	2.72	35.00	13.55	53.99	3.39	146.95	92.96

¹ Stakes at \$2.00 per 1,000, \$10.89 per acre; average life of stakes, 2½ years.

² 2 ties to each stem; plants pruned to 2 stems would require 4 ties.

³ Topping considered an extra pruning.

⁴ Based on average 1930-39 value of \$1.15 per bushel and \$43.35 per ton.

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